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Dark Matter Halos Merging Trees: the Merging Cell Model in a CDM Cosmology

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1. Contents

We have constructed the merging history of dark matter halos in a SCDM cosmology, by means of a the "Merging Cell Model" (MCM; ref: RT96). It is based on the linear theory of growth of density fluctuations, and the Top-Hat model, and it takes into account mergers between halos through simplified criteria.

The halo mass function, the progenitors and children mass distribution, the distribution of formation times, and the halo autocorrelation function have been computed. To test the reliability of the model, results have been compared to the analytical predictions of the extended Press & Schechter (ePS) theory, that in turn well describes results of N-body simulations.

A general good agreement has been found, thus providing us with a reliable tool for rapid simulations of galaxy formation and evolution within hierarchical scenarios. The MCM is particularly suitable for studying galaxy clusters at low redshift, and the population of Lyman-break galaxies at high z.

2. Some results

Some results of the comparison between MCM and analytic predictions are shown in the figures below, while an extensive discussion is in Lanzoni et al. (1999). A SCDM cosmology is adopted, with the following values of the cosmological parameters: $\mathrm{H}_0 = 100\,h\,\mathrm{km\ s^{-1}Mpc^{-1}}$, $h = 0.5$, $\Omega_0 = 1$, $\Omega_\mathrm{b} = 0.05$, $\Omega_\Lambda = 0$, $\sigma_{8/h} = 0.67$. The MCM results are averaged over 10 different realisations with 256^3 base cells, in a comoving volume of $50\,h^{-1}$ Mpc side. The mass resolution is of about $2\times10^9\,h^{-1}\mathrm{M}_\odot$, and the most massive halo typically has a mass of about $5\times10^{14}\,h^{-1}\mathrm{M}_\odot$.

Fig.1: Differential mass function of halos at $z = 0, 3$. Results from the MCM model (histograms) are compared to the analytic prediction of the ePS theory (e.g., LC94; dotted lines), and to the LS98 mass function that better describes results from N–Body simulations (solid lines). An overall good agreement is found, even if a lack of low-mass halos in the MCM model is apparent. Also too few high-mass halos are found, especially at high z.

Fig.2: Differential probability distribution of formation redshifts z_f, for halos in two mass ranges at $z = 0$. Solid curves are the analytic predictions (LC94). Within the error bars, a very good agreement is found for the most massive objects, while severe discrepancies are found for small objects.

Fig.3: Autocorrelation function of halos in two mass ranges, selected at $z = 3$. MCM results circles are compared to the Jing's fitting formula (Jing 1998; solid lines), that provides good fits to N-body simulations. A very good agreement is apparent.

Fig.1:

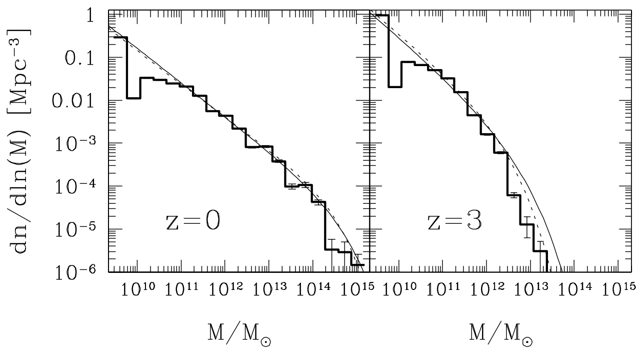


Fig.2:

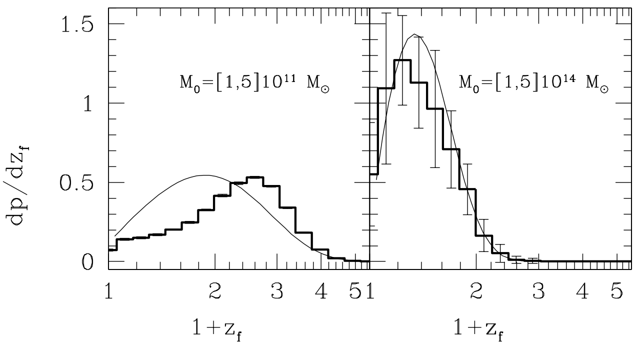
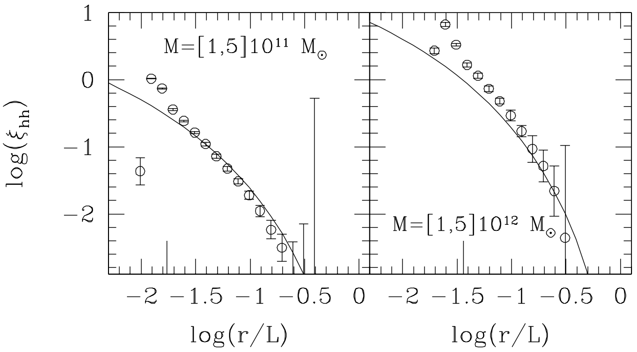


Fig.3:



References

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